instruction manual

BECKMAN/BERKELEY

MODEL 5311-1

PRESET EPUT

I/N ELECT. CALIB.
D/3272-5

Beckman® / *Berkeley Division*

BECKMAN/BERKELEY

MODEL 5311-1

PRESET EPUT

I/N ELECT. CALIB.
D/3272-5

J.O. _____

SERIAL 132

BECKMAN Instruments Inc.
Berkeley Division

Richmond 3, California
25 January, 1961

BECKMAN/BERKELEY

MODEL 5311-1

PRESET EPUT

The BECKMAN/Berkeley Model 5311-1 is a standard Model 5311 with the following exceptions:

1. The addition of a 6th DCU and DCI to the front panel.

2. "Alternate Gate" function in place of the standard TIG function. Changes on the 5311-1 for the "ALT-GATE" function include

   (a) re-wiring of the function switch

   (b) Addition of a "Time Seconds Input" BNC connector on the rear panel.

   The "ALT GATE" (alternate gate) function is intended to be used in conjunction with a Model 5310-5, Eput Meter. The inter-connection of the two units should be as shown in Figure 1. Connected in this way, both units will be gated on and off by the 5311-1 input signal divided by the number N set on the 5311-1. The indicating DCU's on both units will count the time increments selected on the "Time Seconds" switch on the 5310-5. To properly set up the units to "Alternate Gate":

   (a) The display time setting on both units must be less than the gating interval.

   (b) The 5310-5 must be reset while the 5311-1 is counting or if there is no input applied to the 5311-1, the 5310-5 may be reset first, then reset the 5311-1. Resetting the 5311-1 delivers a gate pulse to the 5310-5. The 5310-5 will now be counting and the 5311-1 will be "off". Once the proper sequence has been set up the units will alternately gate on and off from then on.

ADDITIONAL INFORMATION

Should it be desirable to record the reading on the counters, the recording time plus display time must be less than the counting interval.

It must be realized that whenever the 5311-1 is manually reset, it delivers a gate pulse to the 5310-5. If the 5311-1 is reset while the 5310-5 is counting both units will be "off". If the 5310-5 is reset while it is counting both units will be "off". In either of the above cases, the alternate sequence is upset, and the units must be set up again as described under (b) above.

3. Per x N function has been changed to operate as "Period fron N to N + 1" function (the front panel remains engraved PER X N).

   Changes on the 5311-1 for this new PER X N function include

   (a) re-wiring of the function switch

   (b) using the "Time Seconds Input" BNC connector on the rear panel (The "Time Seconds Input" was added for the "ALT GATE" function).

   The new "PER X N" (now actually a period from N to N + 1 function) must be used in conjunction with the Model 5310-5 Eput Meter. The interconnection of the two units should be as shown in Figure 2.

   The 5310-5 must be on "ALT GATE" function to deliver the time base output to the 5311-1.

   When connected as in figure 1 the 5311-1 will divide its input by the number N. When preset count N is reached, the indicating DCU gate will open. On the next input pulse (N + 1 pulse) the indicating DCU's gate closes. The indicating DCU's display the period from input N to N + 1 in the increments of time selected on the 5310-5.

   If the connections are as shown in figure 1 the 5310-5 will gate on and off unless placed on Infinite display, in which case it will gate on and off only once.

4. The reset push button has been replaced by a microswitch and the preset DCU's manual reset circuit modified so as to insure only one preset output per depression of the reset button.

In all other respects the following manual for a standard Model 5311 applies.

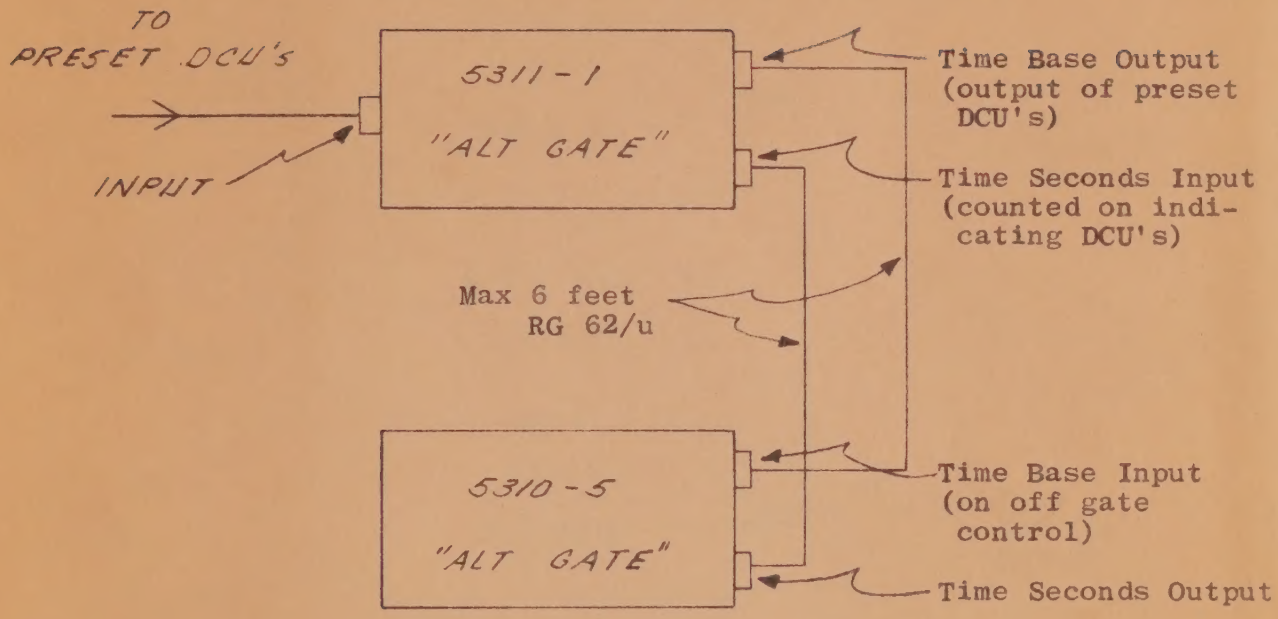

TO
PRESET DCU's
INPUT
5311 - 1
"ALT GATE"
Time Base Output
(output of preset
DCU's)
Time Seconds Input
(counted on indi-
cating DCU's)
Max 6 feet
RG 62/u
5310 - 5
"ALT GATE"
Time Base Input
(on off gate
control)
Time Seconds Output

FIGURE 1

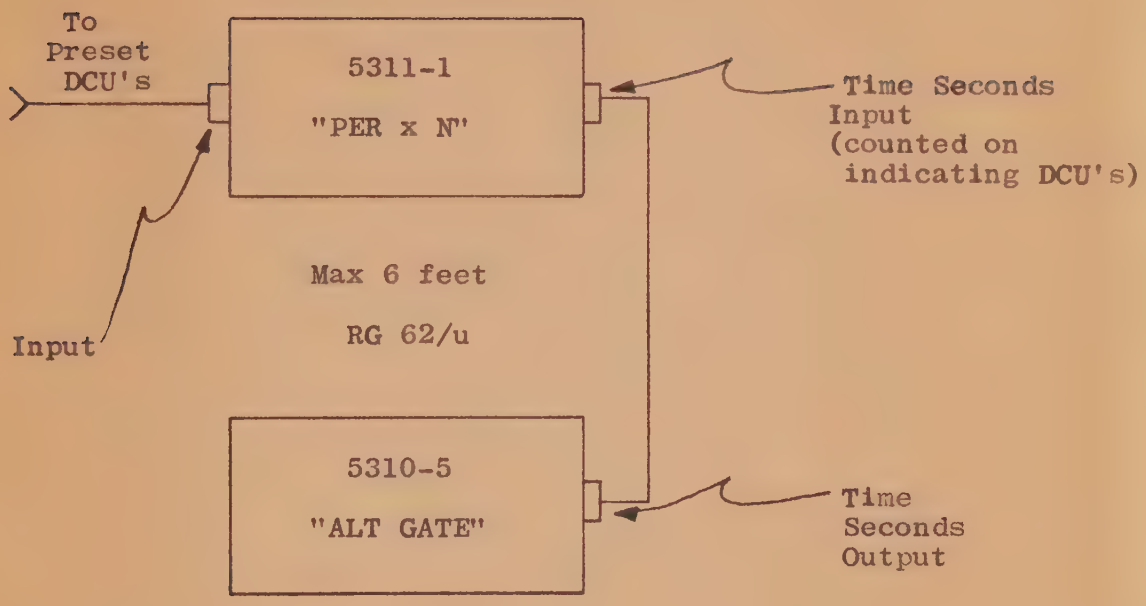
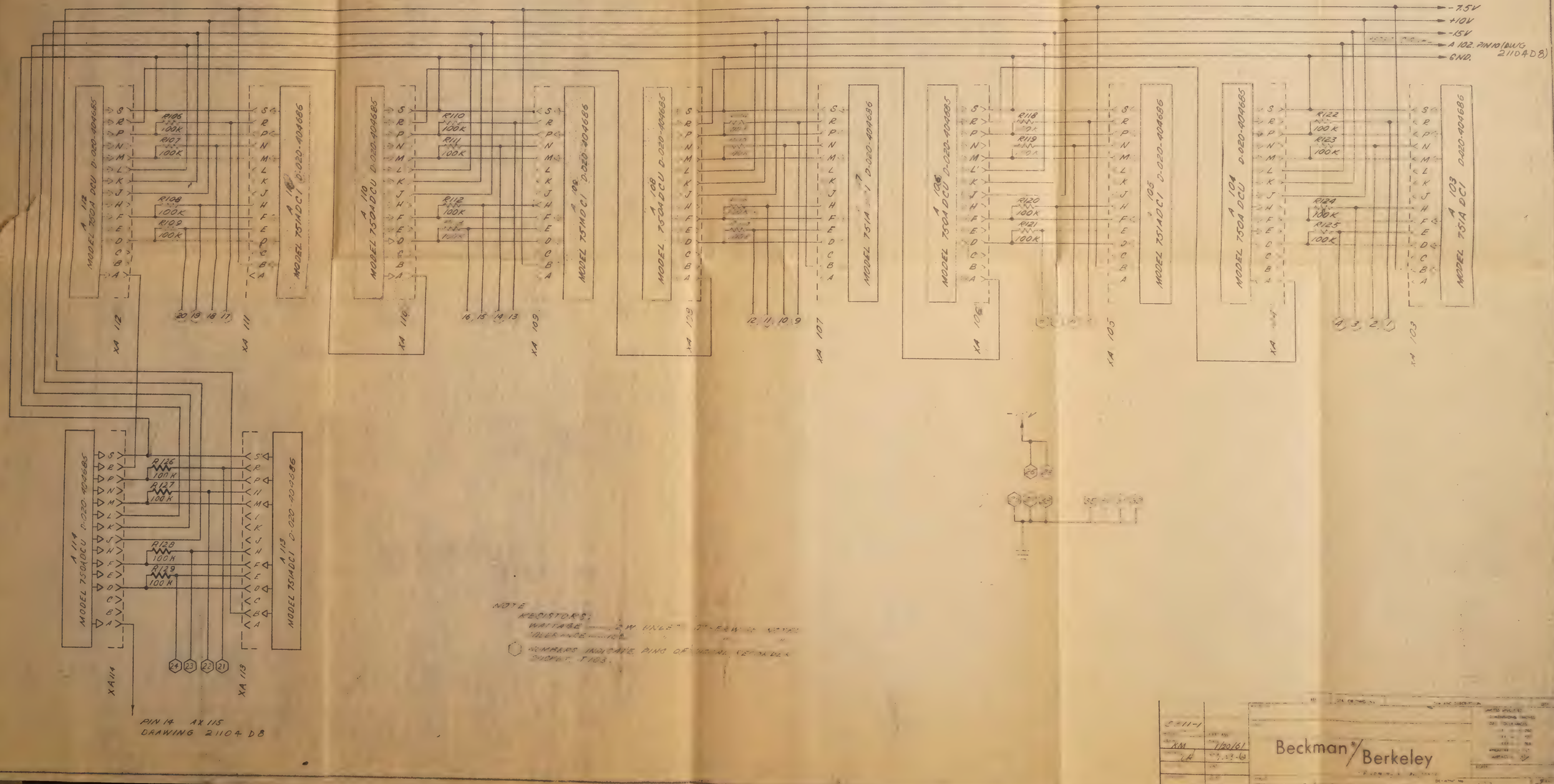

To
Preset
DCU's
5311-1
"PER x N"
Time Seconds
Input
(counted on
indicating DCU's)
Max 6 feet
RG 62/u
Input
5310-5
"ALT GATE"
Time
Seconds
Output

FIGURE 2


-7.5V
+10V
-15V
A 102. PIN 10 (DWG 21104 D 8)
GND.
MODEL 750A DCU D-020-404685
MODEL 751A DCI D-020-404686
A 112
A 111
A 110
A 109
A 108
A 107
A 106
A 105
A 104
A 103
XA 112
XA 111
XA 110
XA 109
XA 108
XA 107
XA 106
XA 105
XA 104
XA 103
R106 100K
R107 100K
R108 100K
R109 100K
R110 100K
R111 100K
R112 100K
R118 10K
R119 10K
R120 100K
R121 100K
R122 100K
R123 100K
R124 100K
R125 100K
20 19 18 17
16 15 14 13
12 11 10 9
4 3 2 1
MODEL 750A DCU D-020-404685
MODEL 751A DCI D-020-404686
A 114
A 113
XA 114
XA 113
R126 100K
R127 100K
R128 100K
R129 100K
24 23 22 21
PIN 14 AX 115
DRAWING 21104 D8
-7.5V
26 25
NOTE
RESISTORS:
WATTAGE ——— .2W UNLESS OTHERWISE NOTED
TOLERANCE ——— 10%
NUMBERS INDICATE PINS OF NORMAL CONNECTOR SOCKET TIES.
E-11-1
XM 1/20/61
LR 2-23-61
Beckman / Berkeley
DRAWING NO. OF PART 21104 D 9

CONTROL PLUG-IN
(855-404190

R301 10K
R303 1.5K, 5%
C301 6.8
R307 1.8K
R302 2.2K
R304 1.8K 5%
C300 500
Q31
Q32
R305 330Ω
R306 1.2K, 5
SHAPER

Q35
R308 2.2K
C302 330
CR301 IN95
PULSE AMP

1 µf 70V

CR303 IN198
R310 22K
R312 3.3K
C305 220
R313 3.3K
R315 15K 5%
R311 15K 5%
R314 15K 5%
C306 150
CR304 IN95
R316 15K, 5%
CR302 IN198
C304 220
R319 15.1 5%
Q36
Q37
R317 33K
R318 33K
START BINARY

CR305 IN198
R320 3.3K
C308 220
R321 33K
R322 5%, 15K
R323, 15K, 5%
CR307 IN95
CR306 IN198
C307 220
CR309 IN95
R324 33K
Q39
Q38
R325 33K
CONTROL BINARY

R326 12K
R327 2.2K
R328
Q33
C309 100
R332 56K
Q34
CR308 IN95
R329 33K
R331 33K
GATE/PULSE AMP

AMPLIFIER DWG NO C020-404598

A115
A B C D E F H J K L M N P R S
XA115
TO PIN A A-114 DWG 21104 D 9

A116
A B C D E F H J K L M N P R S
XA116

R101 100K
C101 .22µf, 600V
R102 25K
SENSITIVITY
-5.6 V (SEE NOTE 3)

AMPLIFIER OUTPUT SIGNAL

-5.6 V (SEE NOTE 3)
R103 5K
TRIGGER LEVEL
+10V
-15V
RESET
(SEE NOTE 3)

FUNCTION SWITCH (S101)

START S101A
ALT GATE
STOP S101B
GATE S101C
INPUT S101D
DOWN S101E

C102 150
C103 150
C104
R105 18K

TIME SECONDS INPUT

IN198
180K
-15V
C108 .01 µf

DWG C-020-404621

RESET PLUG-IN
(855-404187)

R401
R402 33Ω
C401 8µf
R403 8.2K
R404 1K
R405 33Ω
R406 22K
R408 1.2K
R409 3.3K
R410 220K
C402
C404 330
C405
C406 500
Q41
Q42
Q43
CR402 HB4
CR403 IN95
CR404 HB4
CR405 IN95
CR406 HB4
CR407 IN95
CR401 IN536
R412 1K
R411 12K
R413 4.7K
R414 4.7K
R415 1.8K
R416 4.7K
R417 6.8K
R418 100K
R419 33K

A117
A B C D E F H J K L M N P R S
XA117
DISPLAY TIME GENERATOR
COUNTER RESET GENERATOR

FROM PIN R XA123 DWG C-020-404621

S104
R104 1MEG
DISPLAY

+10V
-5V
RESET OUTPUT
(SEE NOTE 3)

S103
RESET
+10 V

NOTES:
1. RESISTORS: WATTAGE IS 1/2 W, EXCEPT AS NOTED. TOLERANCE IS 10%.
2. CAPACITORS: CAPACITY IN µµf, EXCEPT AS NOTED.
3. FOR POWER SUPPLY VOLTAGES SEE DWG C-020-401061.
4. TRANSISTORS: Q31 THRU Q33 - 2N404; Q34 - 2N219; Q42 THRU Q44 - 2N383.
5. J103, DIGITAL RECORDER CONNECTOR.

5311-1

DRN
3/17/61

Beckman Berkeley

PRESET PUT METER SCHEMATIC

21104 D 8 SA

INSTRUCTION MANUAL

MODEL 5311
PRESET EPUT®

Serial No. _____

NOTE

If model number is followed by one or more letters, the instrument covered by this manual has been modified. See section on modifications.

Beckman/ Berkeley Division
Richmond 3, California

January 1960

WARRANTY

Instruments sold by Berkeley Division, Beckman Instruments, Inc., (hereafter called "the Company") are warranted only as stated below.

Subject to the exceptions and upon the conditions specified below, the Company agrees to correct, either by repair, or, at its election, by replacement, any defect of material or workmanship which develops within one year after delivery of the instrument to the original purchaser by the Company or by an authorized representative, provided that investigation and factory inspection by the Company discloses that such defect developed under normal and proper use.

The exceptions and conditions mentioned above are the following:

(a) Some components and accessories by their nature are not intended to, and will not, function one year. If any such component or accessory manufactured by the Company and part of the item sold fails to give reasonable service for a reasonable period of time, the Company will, at its election, replace or repair such component or accessory. What constitutes reasonable service and what constitutes a reasonable period of time shall be determined solely by the Company after the Company is in posession of all the facts concerning operating conditions and other pertinent factors and after such component or accessory has been returned to the Company, transportation prepaid.

(b) All instruments claimed defective must be returned to the Company, transportation charges prepaid, and will be returned to the customer with the transportation charges collect, unless the item is found to be defective in which case the Company will pay all transportation charges.

(c) The Company makes no warranty concerning components or accessories not manufactured by it, such as tubes, fuses, batteries, etc. However, in the event of the failure of any component or accessory not manufactured by the Company, the Company will give reasonable assistance to the purchaser in obtaining from the respective manufacturer whatever adjustment is reasonable in the light of the manufacturer's own warranty.

(d) Except as stated above, the Company makes no warranty, express or implied (either in fact or by operation of law), statutory or otherwise; and, except to the extent stated above, the Company shall have no liability under any warranty, express or implied (either in fact or by operation of law), statutory or otherwise.

(e) The Company expressly disclaims any liability to its customers, dealers, and to users of its products, and to any other person or persons for consequential damages of any kind and from any cause whatsoever arising out of or in any way connected with the manufacture, sale, repair, replacement of, or arising out of or in any way connected with the use of any of its products.

(f) Representations and warranties made by any person, including representatives of the Company, which are inconsistent or in conflict with the terms of this warranty (including but not limited to the limitation of the liability of the Company as set forth above) shall not be binding upon the Company unless reduced to writing and approved by an officer of the Company.

(g) This warranty shall be governed by the laws of the State of California.

Claims for damage in shipment should be filed promptly with the transportation company.

All correspondence concerning the instrument should specify the model and serial number. This information appears on the company name plate. Any inquiry concerning details of operation, possible modifications, etc., should be addressed to the Sales Department, Berkeley division of Beckman Instruments, Inc., Richmond 4, California.

REPAIR SERVICE

Experienced service personnel and special test equipment are available at the factory to perform any necessary repairs. Every effort will be made to expedite the repair of instruments returned for servicing. Repair work will be performed only upon receipt of a written purchase order or authorization. Instruments to be repaired should be addressed to SERVICE AND REPAIR DEPARTMENT with transportation charges prepaid. Repaired instruments will be returned to the purchaser with transportation charges collect.

Berkeley reserves the right to make changes in design at any time without incurring any obligation to modify equipment previously purchased to conform to subsequent design changes.

BERKELEY DIVISION
BECKMAN INSTRUMENTS, INC.

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MODIFICATIONS

DIAGRAMS

Master Schematic Diagram
Input Circuit, Schematic Diagram
Counting Circuit, Schematic Diagram
Clock Pulse Generator, Schematic Diagram
Preset Digital Divider, Schematic Diagram
Coincidence Unit, Schematic Diagram
Power Supply, Schematic Diagram

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APPENDICES

Instruction Manual for Model 750A Decimal Counting Unit

Instruction Manual for Model 751A Decimal Count Indicator

1. INTRODUCTION

1.1 GENERAL DESCRIPTION

The Model 5311 Preset EPUT® is a compact, fully transistorized counting instrument with a time base that can be varied in small steps over a wide range. The unit will count any series of events which can be converted by a transducer into voltage changes of a given magnitude. Its highly variable time base allows this instrument to do the following: count events-per-unit-time over a wide range of time intervals; time a widely varying number of periods of an input signal; count batches of events; generate accurately spaced timing signals of predetermined interval or produce a wide range of time delays.

Basically, the Model 5311 is made up of the functional elements shown in Figure 2. The Input Circuit amplifies and shapes the input signal, while the Clock Pulse Generator produces fixed-interval timing pulses. The Digital Divider produces one output pulse for every N input pulses, N being the number to which the Preset Selectors are set.

When events-per-unit-time are being measured, the DCU's (Decimal Counting Units) count pulses derived from the input signal during the time the Count Gate is open. The Count Gate is opened and closed by signals from the Clock Pulse Generator by way of the Digital Divider and Gate Control Circuits. For period measurements, the DCU's count clock pulses while the Count Gate is controlled by the input signal.

The instrument displays the registered count during a counting period by illuminated decimal digits. It can be set to recycle either automatically or when reset by the operator. The mode of operation, Digital Divider factor (N), and display time are all selected by the operator with front panel controls (see Fig. 1). With its built-in test feature, the Model 5311 can be readily checked to see that it is in good working order.

1.2 TECHNICAL CHARACTERISTICS

Input Frequency Range

10 cps to 200 kc
(10 cps to 100 kc in PER X N and INPUT/N operation)

Maximum Input Sensitivity

0.1 volts rms (0.3 volts peak-to-peak)

Input Impedance

100 K shunted by 5 $\mu\mu$f

Paired Pulse Resolution

3 microseconds

Count Display Capacity

99, 999

Display Time

Continuously variable from 0.1 sec. to approximately 10 sec. Display can also be maintained indefinitely

Digital Divider Range

Can be preset to give one output pulse for every N input pulses, where N is any number from 1 to 199, 999 inclusive

Counting Accuracy

± 1 count ± accuracy of crystal oscillator

Oscillator Stability

Depends on crystal used. Unheated crystal supplied with standard Model 5311 has the following characteristics

Frequency stability: 3 parts in 10^7 per 24 hour period (at 25 deg. C.)

Frequency deviation with temperature: ± 1 part in 10^5 for ±10 degree deviation from 25 degrees C

For characteristics of other crystals available, see MODIFICATIONS section

Outputs Available

Electrical Readout:	1-2-4-8 binary code signals for each digit displayed, available at multi-terminal connector on rear panel
Oscillator Output:	100 kc signal at 0.5 volts rms available at rear panel coaxial connector
Digital Divider Output:	15 volt positive pulses 5 μs wide available at rear panel coaxial connector

Ambient Temperature Range

-20 to +65 degrees C. (-4 to +149 degrees F.)

FIG. 1. This picture of the Model 5311 shows the controls and indicators located on the front panel.

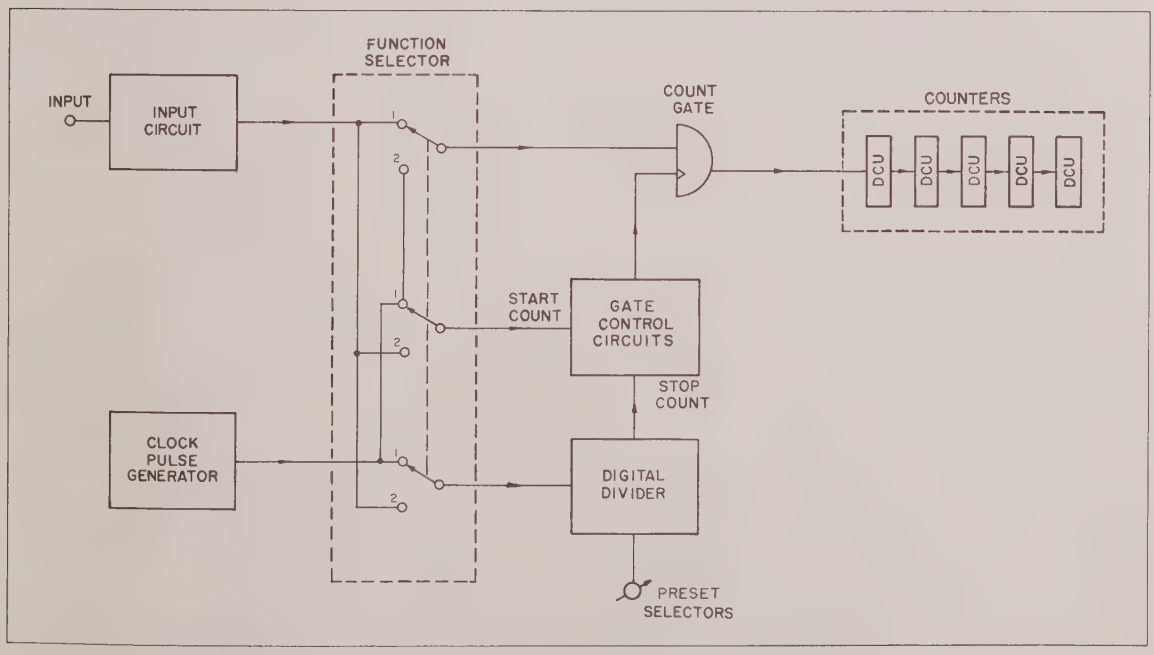


FIG. 2. This simplified block diagram shows how the major functional elements of the 5311 are interconnected for E/UT X N and PER X N measurements. The Function Selector is in position 1 for E/UT X N operation and position 2 for PER X N. The Digital Divider produces one output pulse for every N input pulses, where N is the setting of the Preset Selectors.

Power Required

40 watts. Operates from 117 v (±10%), 50 to 400 cps AC source (with transformer taps provided for nominal 105 v, and 126 v)

Dimensions

With cabinet: 7 1/4 in. high, 21 in. wide, 15 in. deep

Without cabinet: 5 1/4 in. high, 19 in. wide, 12 in. deep

Weight

25 lbs (with cabinet)

1.3 APPLICATIONS

The Model 5311 Preset EPUT® is useful for all counting, timing, and frequency measuring operations in which reliability and portability are important factors. Careful design and rugged construction make this instrument especially suitable for industrial and field testing applications. A number of accessories and auxiliary equipment such as input transducers, printers, data converters and in-line display units are available from Beckman/Berkeley for use with the Model 5311. These greatly extend the utility of the instrument. In addition, specially modified versions of the Model 5311 can be ordered to suit specific applications.

2. OPERATION

2.1 INSTALLING AND ENERGIZING THE INSTRUMENT

The instrument is ready for use as it arrives from the factory and will operate in any environment tolerable to personnel. Moreover, the unit can be operated inside its cabinet, or removed from the cabinet and mounted in a standard 19 inch rack.

To energize the instrument, connect the power cord to a 117 volt AC source and turn the POWER switch on. Although no warm-up period is required, it is advisable to allow about 30 seconds for the circuits to stabilize before operation is begun. (NOTE: For warm-up time needed with a heated crystal, see "Modification D" in section on modifications.)

2.2 OPERATING CONTROLS AND INDICATORS

The following controls and indicators are all located on the front panel of the instrument:

FUNCTION Selector

Selects the mode of operation (see sections 2.4 and 2.6 through 2.11 for a description of each mode).

Preset Selectors (N)

Select the factor, N, by which the digital divider operates. In the PER X N mode, N represents the number of input signal periods timed. In INPUT/N, N is the number by which the input signal frequency is divided; in COUNT, the preset switches are not used. For all other modes, N represents the duration of the time base interval in units of 10 microseconds.

INPUT Jack

A coaxial connector through which the signal being measured is fed to the instrument.

SENSITIVITY Control

Continuously varies the input sensitivity of the instrument by attenuating the signal coming through the INPUT jack. (See section 2.5, "Input Requirements and Adjustments".)

COUNT Indicators

Display the number of counts registered by the instrument. The significance of the readings in each mode of operation is described in the corresponding sections of the manual.

DISPLAY Control

Determines how long the instrument will hold a reading before resetting and beginning another count. Continuously varies the display time from 0.1 seconds to approximately 10 seconds. When the control is switched into its "infinity" position, the instrument will hold a reading until the operator presses the RESET button.

RESET Button

Resets the count indicators to zero and clears the instrument for the next counting period.

2.3 AUXILIARY CONNECTORS AND CONTROLS

The following are all located on the rear panel of the instrument:

EXT(ernal) FREQ(uency) Jack

When the EXT-INT switch is in the EXT position, an external clock signal can be fed through this coaxial connector to substitute for the internal oscillator signal (see section 2.12, Using an External Clock Signal). With the switch at INT, the signal from the internal oscillator (0.5 volts rms at 100 kc) is available at this jack for external use.

EXT(ernal)-INT(ernal) Switch

Determines function of EXT(ernal) FREQ(uency) jack.

TIME BASE OUTPUT Jack

Digital divider output pulses (15 volts high, 5 μs wide) are available at this coaxial connector for external use.

DIGITAL RECORDER Socket

This multi-terminal connector makes available the binary-coded readout signals for use with printers, in-line display units, data converters, or other auxiliary equipment. The terminals of this socket are connected to the binary readout lines from each DCU in the counter as indicated in Table 1. The binary coded output generated by the DCU's for each decimal digit is described in the enclosed DCU manual. (output signal for binary "1" is -12 volts with output resistance of 100 K).

Table 1. Identification of Pin Numbers on DIGITAL RECORDER Socket

ORDER OF DIGIT READ	BINARY CODE POSITIONS			
	FIRST (1)	SECOND (2)	THIRD (3)	FOURTH (8)
Highest	Pin 4	Pin 3	Pin 2	Pin 1
Second	8	7	6	5
Third	12	11	10	9
Fourth	16	15	14	13
Fifth	20	19	18	17

NOTE

Pins 21 through 24 and 25 through 28 are wired to produce a "no print" code (0101).

Pin 39 carries a control signal from the counter to the recorder. This pin is negative (-12 volts) during the display period, and at approximately ground potential from the time of reset to the end of the next counting period.

Pin 40 carries an "inhibit reset" signal from the recorder to the counter. When this pin is grounded, the counter cannot reset.

Pins 30, 31, 32, 35 & 38 are grounded. Pins 22, 24, 26, 29 and 37 remain unconnected.

2.4 TESTING FOR PROPER OPERATION ("TEST" FUNCTION)

The TEST mode makes possible a relatively quick check of the instrument to see that it is functioning correctly. The unit should be checked in this way just before operation is begun, and periodically during extended periods of operation.

To perform a test, proceed as follows:

1) Set DISPLAY control for a short display time (near counterclockwise limit).

2) Set FUNCTION selector at TEST.

3) Rotate the extreme right-hand preset selector through each of its ten positions and note the count displayed at each setting. If the instrument is functioning correctly, the count displayed in each case will be the same as the preset number N.

4) Repeat step 3 for each of the other preset selectors in turn.

(NOTE: The extreme left-hand selector has only two settings, 0 and 1. The instrument correctly displays a count of "00000" at both settings.)

2.5 INPUT REQUIREMENTS AND ADJUSTMENTS

The input signal to the instrument must have an amplitude of at least 0.1 volts rms (0.3 volts peak-to-peak) and a frequency within the range of 10 cps to 200 kc (10 cps to 100 kc for PER X N and INPUT/N operation). Signals with amplitudes up to 500 volts (DC level plus AC peak) can safely be used. The AC component, however, must not exceed 100 volts rms. The impedance between the INPUT connector and chassis ground is 0.1 megohms with a shunt capacitance of 5$\mu\mu$f.

The SENSITIVITY control attenuates the signal applied to the INPUT connector. Starting at the counterclockwise limit, the control should be rotated slowly clockwise to a point just beyond where the instrument begins to count reliably.

2.6 MEASURING EVENTS PER UNIT TIME ("E/UT X N" FUNCTION)

2.6.1 Description of the E/UT X N Mode. In this mode of operation, the unit counts the cycles of the input signal for a preselected period of time, then displays the total count registered at the end of the period. The length of the counting period is determined by the setting of the preset selectors, and can be varied from 10 microseconds to 1.99999 seconds in 10 microsecond steps.

2.6.2 Operating Procedure. To measure events per unit time, proceed as follows:

1) Couple the signal being measured to the INPUT connector (see section 2.5 for input signal requirements).

2) Set the FUNCTION selector at E/UT X N.

3) Set the preset selectors for the required counting period; the length of the counting period will be 10 microseconds times N, the setting

of the selectors. For example, to obtain a period of 0.778 seconds, the selectors are set so that N is "077800". (NOTE: If the frequency of the signal being measured is higher than 100 kc and the reading must include the most significant figure, the longest counting period which can be used is 0.1 seconds.)

4) Adjust the SENSITIVITY control as described in section 2.5.

5) Adjust the DISPLAY control so that the count is displayed for a convenient length of time. If each reading is to be displayed until the instrument is manually reset, turn the DISPLAY control into its "infinity" position (as indicated by a switch click).

2.7 MEASURING A NUMBER OF PERIODS ("PER X N" FUNCTION)

2.7.1 Description of the PER X N Mode. In this mode, the instrument times a preselected number of periods of the input signal in units of 10 microseconds. Any whole number of periods from 1 to 199,999 can be timed by setting the preset selectors to the required number. (Maximum input frequency for this operating mode is 100 kc.)

2.7.2 Operating Procedure: To make a period measurement, proceed as follows:

1) Couple the signal being measured to the INPUT connector (see section 2.5 for input signal requirements).

2) Set the FUNCTION selector at PER X N.

3) Set the preset selectors to the number of periods to be timed. For example, to measure the duration of 1200 periods, set the switches so that N is "001200".

4) Adjust the SENSITIVITY control as described in section 2.5.

5) Adjust the DISPLAY control so that the count is displayed for a convenient length of time. If each reading is to be displayed until the instrument is manually reset, turn the DISPLAY control into its "infinity" position (as indicated by a switch click).

6) Read the count displayed by the digital indicators. This number represents the duration of N periods in 10 microsecond units.

2.8 COUNTING EVENTS ("COUNT" FUNCTION)

2.8.1 Description of the COUNT Mode. In this mode, the unit continually counts the cycles of the input signal as long as the FUNCTION selector remains in the COUNT position. Since the time base generator is not used in this mode of operation, the count indicated by the instrument is merely a tally of the total number of events which have occurred.

2.8.2 Operating Procedure. To count events, proceed as follows:

1) Couple the signal being counted to the INPUT connector (see section 2.5 for signal requirements).
2) Set the FUNCTION selector at OFF.
3) Press the RESET button to clear the digital indicators.
4) Turn the FUNCTION selector to COUNT to start counting.
5) Turn the FUNCTION selector to OFF to stop counting.
6) Read the count displayed by the digital indicators. To resume counting without clearing the accumulated count indication, turn the FUNCTION selector back to COUNT without pressing the RESET button.

2.9 COUNTING GROUPS OF EVENTS ("INPUT/N" FUNCTION)

2.9.1 Description of the INPUT/N Mode. In this operating mode, the instrument registers one count for every N cycles of the input signal; N being the setting of the preset selectors. The instrument will thus tally batches of 2 to 199,999 items each. The unit continues to count in this way as long as the FUNCTION selector remains in the INPUT/N position. (Maximum input frequency for this operating mode is 100 kc.)

2.9.2 Operating Procedure. To count groups of events, proceed as follows:

1) Couple the signal being counted to the INPUT connector (see section 2.5 for input signal requirements).
2) Set the FUNCTION selector at OFF.
3) Press the RESET button to clear the digital indicators.
4) Set the preset selectors so that N equals the number of items, or events, in each group being tallied.
5) Turn the FUNCTION selector to INPUT/N to start counting.
6) Turn the FUNCTION selector to OFF to stop counting.
7) Read the count displayed by the digital indicators. To resume counting without clearing the accumulated count indication, turn the FUNCTION selector back to INPUT/N without pressing the RESET button.

2.10 GENERATING TIME SIGNALS ("TIG" FUNCTION)

2.10.1 Description of the TIG Mode. In this mode, the instrument operates as a time interval generator rather than as a measuring device; it produces output pulses separated by a preselected time interval. The pulse interval is determined by the setting of the preset selectors, and can be varied from 10 microseconds to 1.99999 seconds in 10 microsecond steps.

2.10.2 Operating Procedure. To use the instrument as a time interval generator, proceed as follows:

1) Set the FUNCTION selector at TIG.

2) Set the preset selectors for the required time interval; the interval will be equal to 10 microseconds times N, the setting of the selectors.

3) Output pulses separated by the preselected time interval will continually appear at the TIME BASE OUTPUT connector at the rear of the unit. These pulses are about 15 volts high and 5 microseconds wide.

2.11 PRODUCING TIME DELAYS ("DELAY" FUNCTION)

2.11.1 Description of the DELAY Mode. In this mode, the instrument acts as a time delay generator and operates in a manner similar to "TIG". In this case, however, the unit produces a single output pulse after a triggering signal has been applied to the INPUT jack and the preselected interval has elapsed. The repetition rate of the input triggering signal is limited by the minimum display time (0.1 sec.) plus the delay interval.

2.11.2 Operating Procedure. To use the instrument as a time delay generator, proceed as follows:

1) Set the FUNCTION switch at DELAY.

2) Set the preset selectors for the required time delay. The delay interval will be 10 microseconds times N, the setting of the selectors.

3) Apply a "start" signal to the INPUT connector (this signal must have a minimum peak amplitude of 0.15 volts).

4) At the end of the delay period, an output pulse (15 volts high, 5 μs wide) will appear at the TIME BASE OUTPUT connector and the time delay will be displayed by the digital indicators.

2.12 USING AN EXTERNAL CLOCK SIGNAL.

For time base intervals other than those available on the instrument, an external source of clock signals can be used in place of the oscillator in the Time Base Generator. To do this, couple the external clock signal to the connector labeled EXT FREQ on the back of the instrument, and put the EXT-INT switch in the EXT position. The external signal must have an amplitude of 3 volts rms (into a 3000 ohm load); it can have a frequency as high as 100 kc. The time base interval will be equal to N, the setting of the preset selectors, times the period of the external clock signal.

NOTE

At frequencies much lower than 1 kc, capacitor C105 (dwg. no. 5311 C 1) may attenuate the signal below the usable level. In such a case, this capacitor should be shorted with a jumper wire and a larger capacitor connected between the signal source and the EXT FREQ connector.

The EXT FREQ connector also makes it possible to measure the ratio of two frequencies. For example, assume that the higher of two frequencies is fed to the INPUT connector and the lower to the EXT FREQ connector. With the FUNCTION selector at E/ UT X N and the preset selectors at "000001", the instrument will count the number of cycles of the higher frequency for each period of the lower one. The count displayed, therefore, will be the ratio of the two frequencies.

3. SERVICING

3.1 ROUTINE ADJUSTMENTS

3.1.1 Adjusting the Oscillator Frequency. The frequency of oscillation can be adjusted by a small amount with the XTAL ADJ control at the top of the chassis. To make this adjustment, rotate the control until the output of the oscillator (XA101, pin F) produces a zero beat with a signal from WWV or some other highly accurate frequency standard.

NOTE

Whenever the oscillator crystal is replaced, it may be necessary to change capacitor C107 so that the frequency of oscillation can be adjusted to 100 kc.

3.1.2 Adjusting the Trigger Level. The trigger level of the input Shaper circuit has initially been set at the factory, and should normally require no readjustment unless either of the Shaper transistors (Q31, Q32) has been changed. This adjustment should, however, be checked if the input sensitivity of the instrument begins to decrease. To make the adjustment, proceed as follows:

With the SENSITIVITY control in the extreme clockwise position, feed in a sine wave signal having a frequency of about 100 kc and an amplitude of 0.1 volt rms. Using an oscilloscope to observe the Shaper output at the collector of Q32, adjust the TRIGGER LEVEL control on top of the chassis so that the positive and negative portions of the signal have equal pulse widths. Now gradually reduce the input signal amplitude to the minimum at which you can still keep the pulse widths equal.

3.2 GENERAL SERVICING PROCEDURES

3.2.1 Plug-in Modules. The Model 5311 has been designed for long, trouble-free operation and should rarely need servicing. Whenever trouble does occur, and is isolated to a particular plug-in module, it is recommended that the module be replaced with a spare, and the nearest factory representative contacted for repair of the defective unit.

3.2.2 Checking DCU's. If a DCU appears not to be functioning, try interchanging it with a unit in a lower decimal position. If it still does not operate, the unit has a defect and should be replaced.

3.2.3 Printed Circuit Connector Contacts. Whenever a plug-in module is removed from its socket, the connector contacts on the printed circuit board should be inspected and cleaned, if necessary. The recommended method for cleaning these contacts is buffing with a clean ink eraser.

In servicing the instrument, care should be taken to avoid shorting printed circuit connector terminals with probes or other tools

MODIFICATIONS

A modified instrument is identified by one or more letters after the model number. For example, a Model 5311BD is a standard Model 5311 Preset EPUT® modified as described in this section under "Modification B" and "Modification D". The modifications do not necessarily appear in this section in alphabetical order.

MODIFICATION B

This modification extends the range of the Digital Divider by a factor of 10. It includes the addition of another Model 750A DCU (A122) and a preset selector switch to the Digital Divider circuit (see schematic diagram).

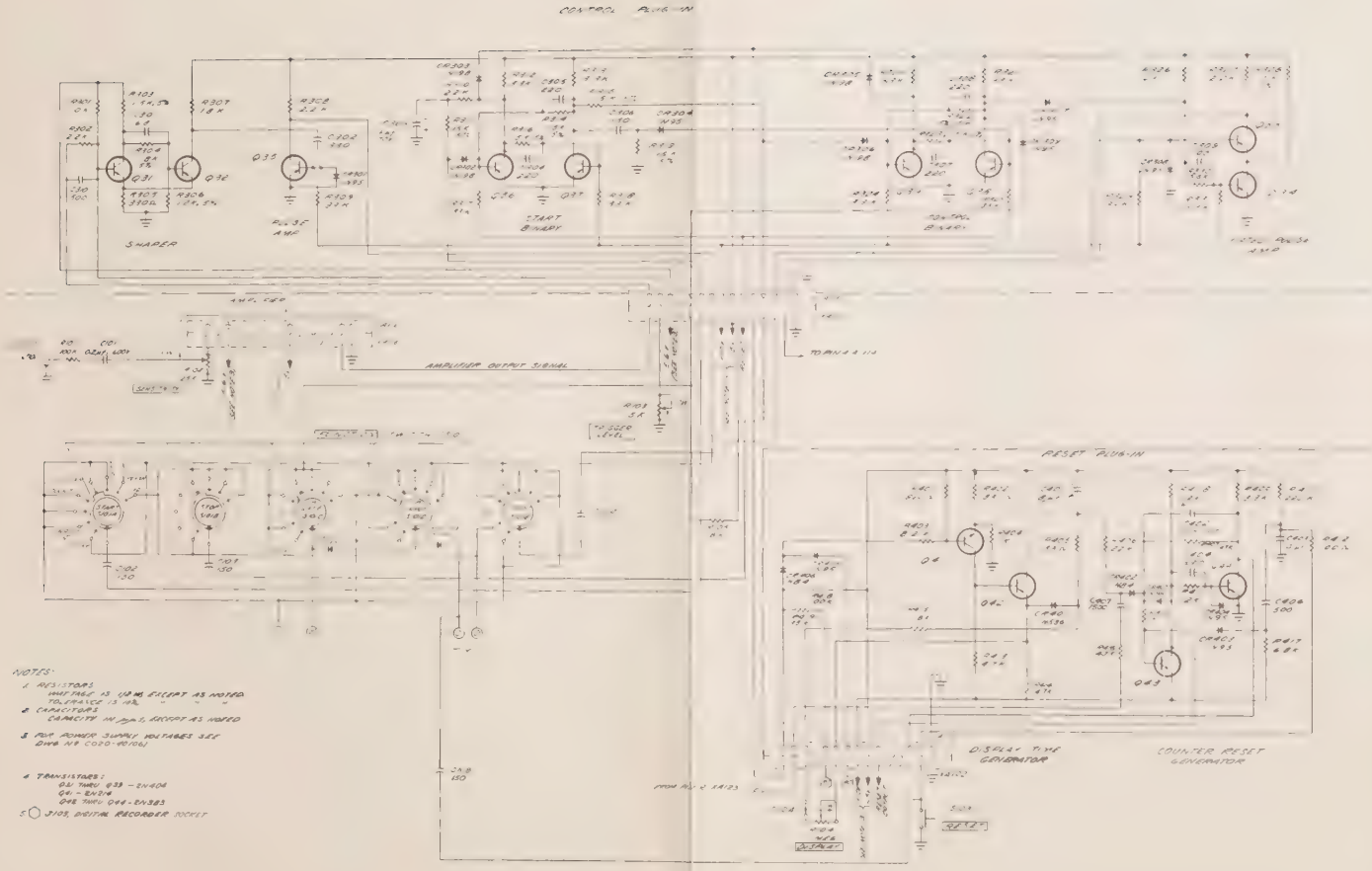
This modification also makes it possible for the operator to extend the total counting period to any multiple of the preset time base interval. To use this mode of operation proceed as follows:

1) Couple the signal being measured to the INPUT connector (see section 2.5 for input signal requirements).
2) Set the FUNCTION selector at E/UT X N.
3) Set the preset selectors for a convenient submultiple of the total counting period. For example, if the counting time wanted is 60 seconds, the selectors could be set for 10 seconds (1000000).
4) Adjust the SENSITIVITY control as described in section 2.5.
5) Rotate the DISPLAY control clockwise into its "infinity" position (as indicated by a switch click).
6) Press the RESET button. The instrument will automatically begin a preset counting period. Before the end of this period, turn the FUNCTION selector to COUNT and begin timing a period equal to the total counting time wanted minus one preset period. For example, if the total counting time is to be 60 seconds, and the preset selectors are set for 10 seconds, the interval to be timed is 50 seconds.
7) At the end of the interval being timed, turn the FUNCTION selector back to E/UT X 10. When the instrument stops counting, read the count displayed by the digital indicators.

MODIFICATION D

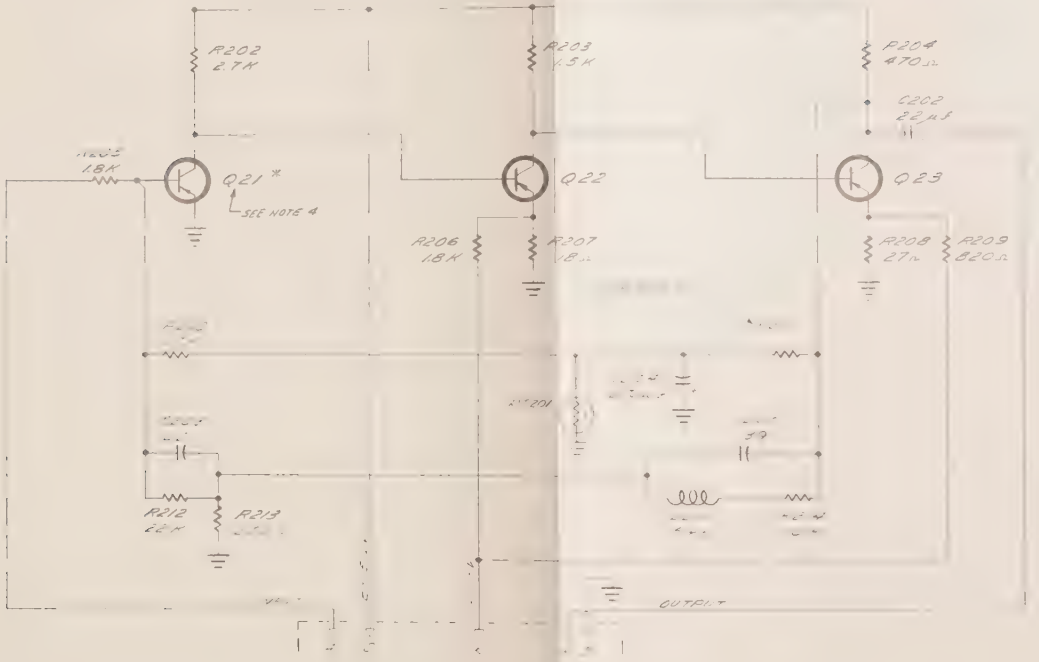
In this modification, the instrument uses a temperature-controlled crystal in the oscillator. This crystal has a stability of 5 parts in 10^7 per 24 hour period at ambient temperature of 15 to 35 degrees C. and a frequency variation of 3 parts in 10^6 over an ambient range of -20 to +65 degrees C.

The heaters in the crystal oven become energized as soon as the power cord of the instrument is plugged into an AC source. Starting at room temperature, the oven will bring the crystal to its stable operating temperature within about half an hour. Therefore, if the instrument is to be used intermittently, the power cord should remain connected even when the instrument is not in operation. This eliminates waiting for the crystal to warm up each time the POWER switch is turned on.


CONTROL PLUG-IN
SHAPER
PULSE AMP
START BINARY
CONTROL BINARY
AMPLIFIER OUTPUT SIGNAL
TO PIN A & 11A
PRESET PLUG-IN
DISPLAY TYPE GENERATOR
COUNTER PRESET GENERATOR
NOTES:
1. RESISTORS
WATTAGE IS 1/2 W EXCEPT AS NOTED
TOLERANCE IS 10%
2. CAPACITORS
CAPACITY IN μμf, EXCEPT AS NOTED
3 FOR POWER SUPPLY VOLTAGES SEE
DWG NO 0200-450081
4 TRANSISTORS
Q2, THRU Q33 - 2N404
Q41 - 2N316
Q42 THRU Q44 - 2N383
5 3103, DIGITAL RECORDER SOCKET

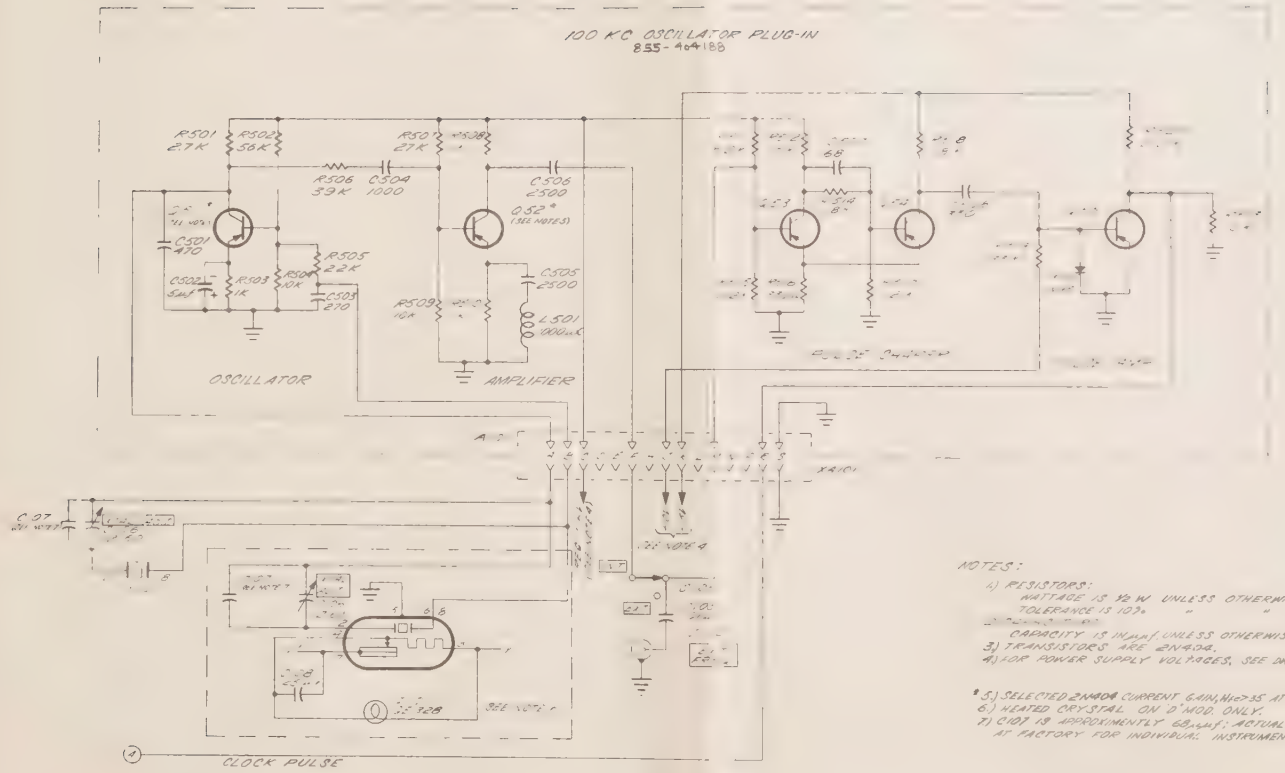
NOTES:

1. RESISTORS:
   WATTAGE IS 1/2 W, UNLESS OTHERWISE NOTED.
   TOLERANCE IS 10%, " "
2. CAPACITORS:
   CAPACITY IS IN μμf, UNLESS OTHERWISE NOTED.
3. TRANSISTORS ARE 2N404.
* 4. SELECTED 2N404, COLLECTOR CUT OFF CURRENT, I_{CBO} < 1 μa., CURRENT GAIN, h_{fe}, RANGE AS TO 60 AT V_C = 3V, I_C = 2 ma.
5. VALUE OF R211 (SELECTED AT FACTORY) IS BETWEEN 15K AND 33K.



COUNTING CIRCUIT
SCHEMATIC DIAGRAM

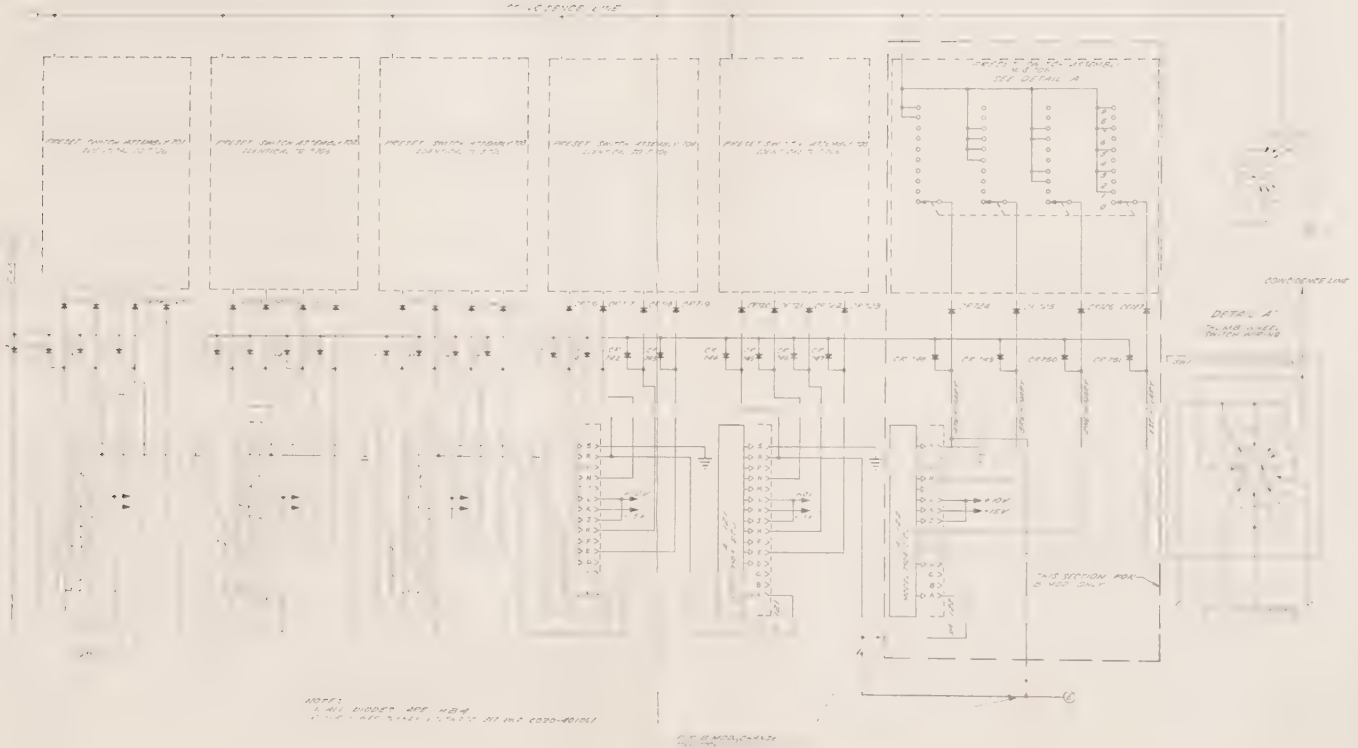
NOTE
RESISTANCE — IN Ω, UNLESS OTHERWISE SPECIFIED
TOLERANCE — ±10%
○ NUMBERS INDICATE PINS OF DIGITAL RECEPTACLE SOCKET, J101

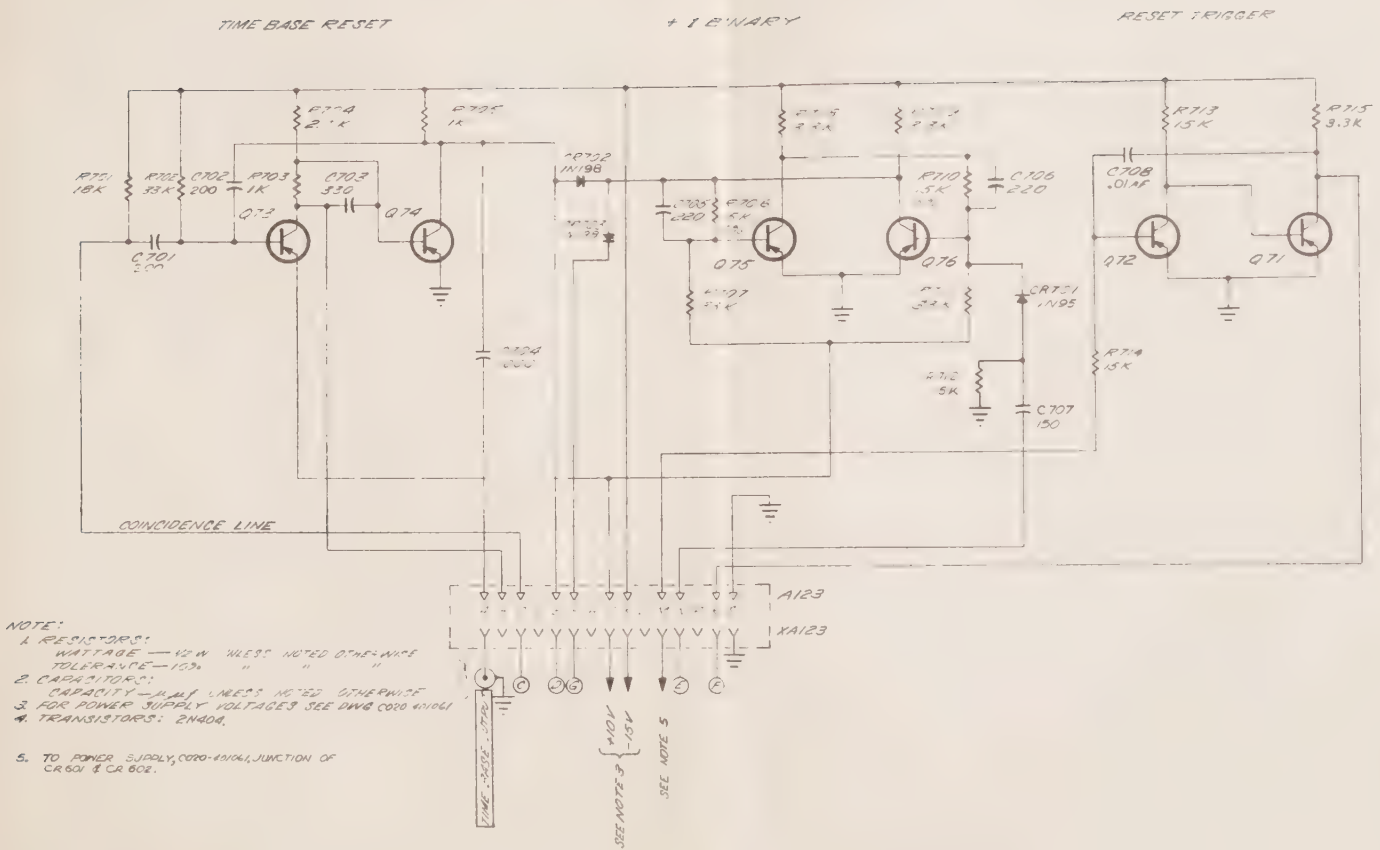


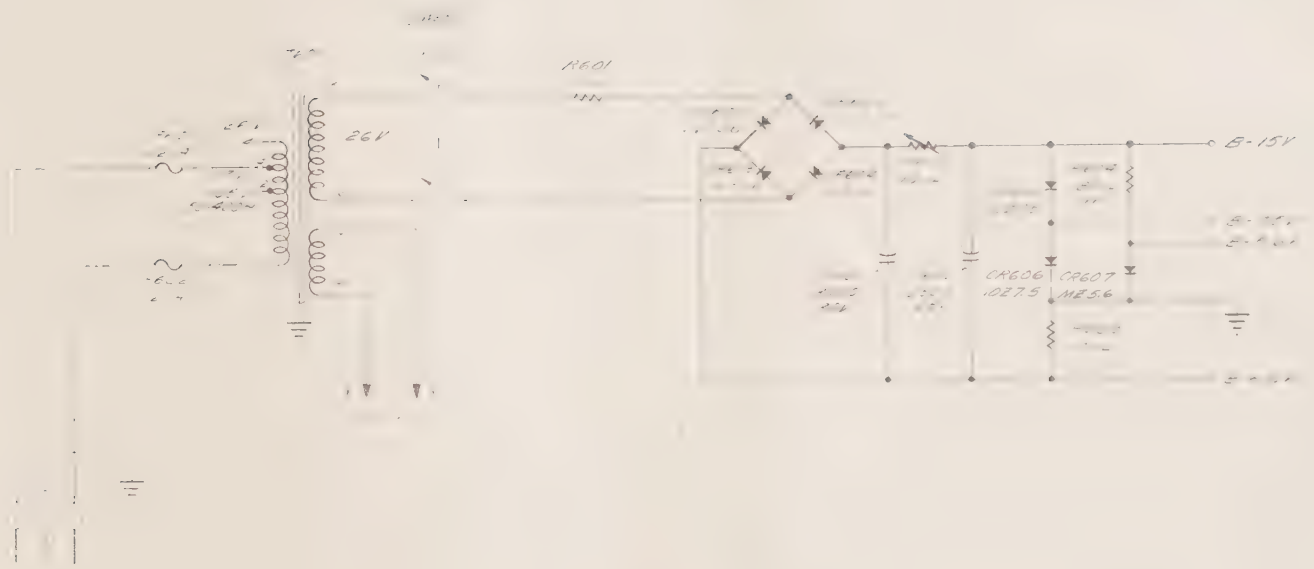
NOTES:
1) RESISTORS:
WATTAGE IS ½ W UNLESS OTHERWISE NOTED
TOLERANCE IS 10% " " "
CAPACITY IS IN μμf UNLESS OTHERWISE NOTED.
3) TRANSISTORS ARE 2N404A.
4) FOR POWER SUPPLY VOLTAGES, SEE DWG No. C1200-400H.

* 5) SELECTED 2N404 CURRENT GAIN, H_{fe}=35 AT V_c=6V, I_c=2ma.
6) HEATED CRYSTAL ON D'MOD. ONLY.
7) C107 IS APPROXIMATELY 68 μμf; ACTUAL VALUE SELECTED AT FACTORY FOR INDIVIDUAL INSTRUMENT.

PRESET DIGITAL DIVIDER
SCHEMATIC DIAGRAM




TIME BASE RESET
+ 1 BINARY
RESET TRIGGER
R714 2.1K
R715 1K
R712 1N198
R713 15K
R715 9.3K
R711 18K
R702 33K
C702 200
R703 1K
C703 330
Q73
Q74
C701 200
C704 600
C705 220
R706 5K
Q75
R710 .5K
C706 220
Q76
R707 5K
CR701 1N95
C708 .01 Mf
Q72
Q71
R714 15K
R716 5K
C707 150
COINCIDENCE LINE
A123
XA123
-15V
SEE NOTE 5
NOTE:
1. RESISTORS:
WATTAGE — 1/2 W UNLESS NOTED OTHERWISE
TOLERANCE — 10% " "
2. CAPACITORS:
CAPACITY — μμf UNLESS NOTED OTHERWISE
3. FOR POWER SUPPLY VOLTAGES SEE DWG COPD 4N1061
4. TRANSISTORS: 2N404.
5. TO POWER SUPPLY, COPD-4N1061, JUNCTION OF CR601 & CR602.



NOTES:

1. RESISTORS:
   WATTAGE IS 1/2W UNLESS OTHERWISE NOTED.
   TOLERANCE IS 10% " " " "
2. CAPACITORS:
   CAPACITY IS 1 MFD UNLESS OTHERWISE NOTED.

INSTRUCTION MANUAL

MODEL 750A
DECIMAL COUNTING UNIT

Beckman/Berkeley Division
Richmond, California

April 1961

WARRANTY

Instruments sold by Berkeley Division, Beckman Instruments, Inc., (hereafter called "the Company") are warranted only as stated below.

Subject to the exceptions and upon the conditions specified below, the Company agrees to correct, either by repair, or, at its election, by replacement, any defect of material or workmanship which develops within one year after delivery of the instrument to the original purchaser by the Company or by an authorized representative, provided that investigation and factory inspection by the Company discloses that such defect developed under normal and proper use.

The exceptions and conditions mentioned above are the following:

(a) Some components and accessories by their nature are not intended to, and will not, function one year. If any such component or accessory manufactured by the Company and part of the item sold fails to give reasonable service for a reasonable period of time, the Company will, at its election, replace or repair such component or accessory. What constitutes reasonable service and what constitutes a reasonable period of time shall be determined solely by the Company after the Company is in posession of all the facts concerning operating conditions and other pertinent factors and after such component or accessory has been returned to the Company, transportation prepaid.

(b) All instruments claimed defective must be returned to the Company, transportation charges prepaid, and will be returned to the customer with the transportation charges collect, unless the item is found to be defective in which case the Company will pay all transportation charges.

(c) The Company makes no warranty concerning components or accessories not manufactured by it, such as tubes, fuses, batteries, etc. However, in the event of the failure of any component or accessory not manufactured by the Company, the Company will give reasonable assistance to the purchaser in obtaining from the respective manufacturer whatever adjustment is reasonable in the light of the manufacturer's own warranty.

(d) Except as stated above, the Company makes no warranty, express or implied (either in fact or by operation of law), statutory or otherwise; and, except to the extent stated above, the Company shall have no liability under any warranty, express or implied (either in fact or by operation of law), statutory or otherwise.

(e) The Company expressly disclaims any liability to its customers, dealers, and to users of its products, and to any other person or persons for consequential damages of any kind and from any cause whatsoever arising out of or in any way connected with the manufacture, sale, repair, replacement of, or arising out of or in any way connected with the use of any of its products.

(f) Representations and warranties made by any person, including representatives of the Company, which are inconsistent or in conflict with the terms of this warranty (including but not limited to the limitation of the liability of the Company as set forth above) shall not be binding upon the Company unless reduced to writing and approved by an officer of the Company.

(g) This warranty shall be governed by the laws of the State of California.

Claims for damage in shipment should be filed promptly with the transportation company.

All correspondence concerning the instrument should specify the model and serial number. This information appears on the company name plate. Any inquiry concerning details of operation, possible modifications, etc., should be addressed to the Sales Department, Berkeley division of Beckman Instruments, Inc., Richmond 4, California.

REPAIR SERVICE

Experienced service personnel and special test equipment are available at the factory to perform any necessary repairs. Every effort will be made to expedite the repair of instruments returned for servicing. Repair work will be performed only upon receipt of a written purchase order or authorization. Instruments to be repaired should be addressed to SERVICE AND REPAIR DEPARTMENT with transportation charges prepaid. Repaired instruments will be returned to the purchaser with transportation charges collect.

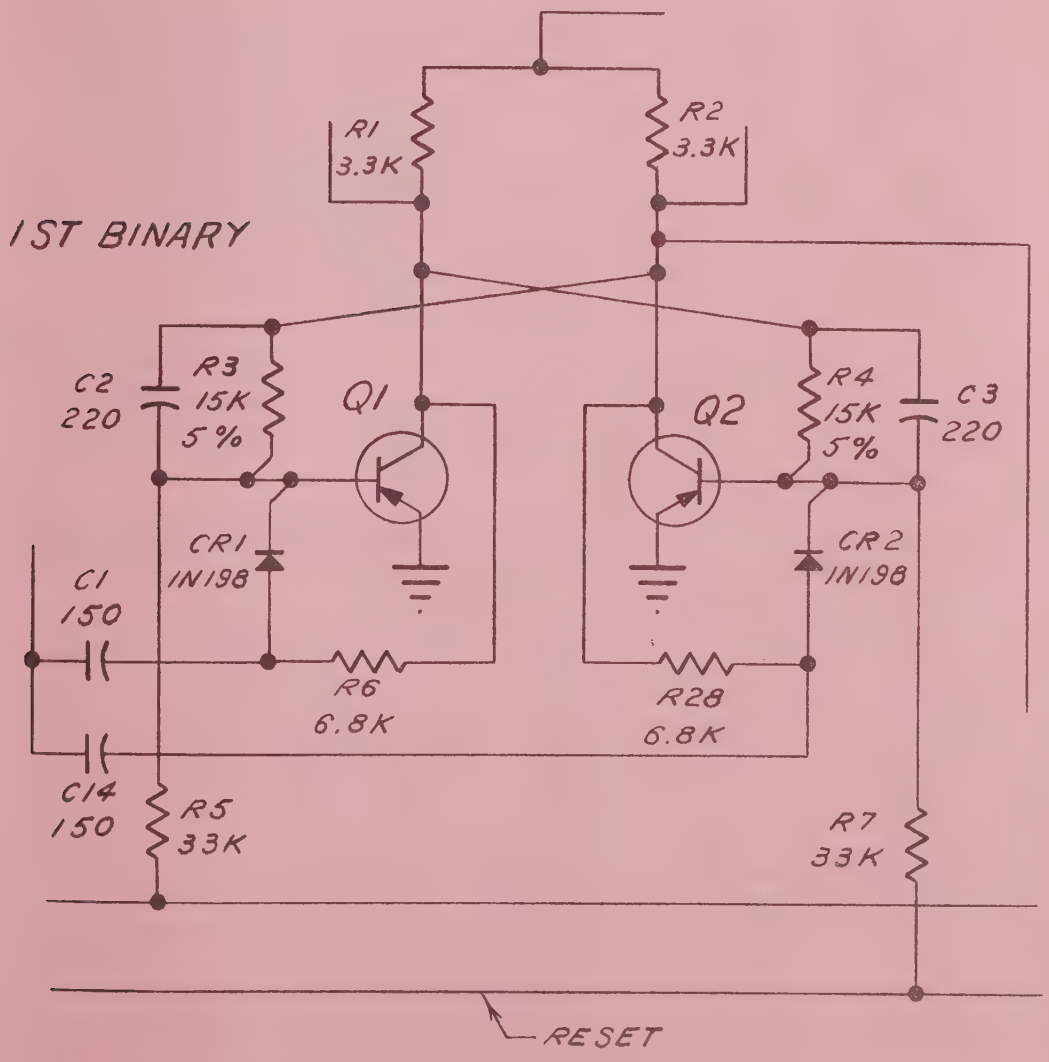
Berkeley reserves the right to make changes in design at any time without incurring any obligation to modify equipment previously purchased to conform to subsequent design changes.

BERKELEY DIVISION
BECKMAN INSTRUMENTS, INC.

INSTRUCTION MANUAL REVISION

Model 750A, lots 1 through 8 (Does not apply to lots 1A through 8A).

Please note that the First Binary circuit is somewhat different from that shown in the schematic diagram. The revised circuit is as follows:



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1. INTRODUCTION

1.1 GENERAL DESCRIPTION

The Model 750A DCU is a plug-in electronic counting unit made up entirely of solid state components mounted on a printed circuit board. The unit provides a count of input pulses from zero to nine, each count being represented by output signals in binary (1-2-4-8) coded form. With a Model 751A Decimal Count Indicator, this binary-coded output can be converted into a decimal digit display of the registered count.

At every tenth input pulse, the counter is reset to zero and simultaneously generates an output signal which can be used to drive another Model 750A DCU. Thus, any number of these units can be cascaded (the output of one connected to the input of the next) to form a counter whose total count capacity depends only on the number of DCU's.

Since each DCU generates one output pulse for every ten input pulses, these units can also be used as decade frequency dividers.

1.2 TECHNICAL CHARACTERISTICS

Count Indication

Binary-coded (1-2-4-8) electrical signals

Input Requirements

Voltage pulse, +10 to +25 volts amplitude*, 1μs minimum duration (0.5μs rise time).

Maximum Counting Rate

200,000 counts per second

Resolution of Paired Pulses

3 microseconds

---

*The values given correspond to supply voltage levels listed under "Power Requirements". For values when other supply voltages are used, see Section 2.6.

Output Characteristics

Positive signal when count goes from "9" to "0", suitable for driving another Model 750A DCU.

Reset Requirement

Voltage pulse, -16 v amplitude*, 20μs minimum duration.

Power Requirements

22 ma at -15 v. (±5%)
2 ma at +10 v. (±5%)

(NOTE: The unit can operate at other voltage levels as well; see Section 2.6).

Construction

Printed card plug-in unit (with 15-pin printed circuit connector).

Dimensions

1/2 inch wide, 4-1/16 inches high, 4-1/2 inches deep

Weight

2-1/2 oz.

*The values given correspond to supply voltage levels listed under "Power Requirements". For values when other supply voltages are used, see Section 2.6.

2. OPERATION

2.1 MOUNTING THE UNIT

The DCU can be mounted by plugging into a 15-pin printed-card connector. When plugged into a connector having lettered terminals, the DCU should be inserted so that the INPUT line on the card corresponds to terminal A on the connector.

2.2 SUPPLYING POWER

Ordinarily, the unit operates with supply voltages of -15 volts and +10 volts, but other voltage levels can be substituted as indicated in Section 2.6. The negative voltage supply should be connected to pin K of the DCU connector, while the positive supply should be connected to pin J.

2.3 SUPPLYING INPUT SIGNALS

Connect the source of input signals to pin A of the DCU connector. The unit will register a count each time a pulse +10 to +25 volts in amplitude (with a minimum width of 1μs and a 0.5μs rise time) is applied to the input terminal.

2.4 USING OUTPUT SIGNALS

The unit provides readout signals in the form of high and low potentials at eight terminals of the DCU connector. These signals indicate the state of each binary and hence the registered count in 1-2-4-8 binary code.

At terminals E, H, N and R, the high potential indicates that the corresponding binary is in the "one" state, while the low potential represents the "zero" state. At terminals D, F, M and P, on the other hand, the potentials for each state are reversed. That is, the "one" state is represented by the low level and the "zero" state by the high level. Table I indicates the state of the binaries for each registered count from 0 to 9.

Table I. State of the Binaries

REGISTERED COUNT	FIRST BINARY	SECOND BINARY	THIRD BINARY	FOURTH BINARY
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

With a B- supply of -15 volts, the high potential has a value of about -12 volts with respect to ground (pin S) while the low potential is at about zero volts. Each readout line will supply a maximum steady state current of 2 ma into a load connected to B-.

The readout signals at terminals D, F, M and P can be used to drive a Model 751A DCI for a visual indication of the registered count. In addition, the output signal produced at terminal R each time the count goes from 9 to 0 can be used to drive another Model 750A DCU or other circuitry.

2.5 RESETTING COUNTER TO ZERO

While the unit is counting, the reset line (terminal L) must be clamped at the level of the B+ supply (+10 volts). The unit can be reset to zero by a negative voltage pulse applied to terminal L of the DCU connector. This pulse must have an amplitude of -16 volts with respect to the +10 v. level, and a duration of at least 20 microseconds. It can be generated either electronically by a transistor circuit or mechanically through relay contacts.

NOTE

Whenever DCU's are connected in cascade, the reset signal must have a minimum duration equal to 20 microseconds times the number of units in the chain in order to reset all of them.

2.6 SPECIAL OPERATING CONDITIONS

Although the operating characteristics described in previous sections are for power supply levels of -15 and +10 volts, the unit will function at other voltages as well. In fact, proper combinations of B- and B+ voltages down to -8 and +4 volts respectively can successfully be used.

Those characteristics which are affected by the supply voltage levels will naturally vary with the value of the voltages used. Thus, for example, with a B- and B+ voltage of -8 and +4 volts, the amplitudes of the input, output, and reset signals will be approximately as follows (signal widths remain unchanged):

1)	Input signal:	+5 to +15 volts
2)	Output signal:	Potentials of 0 and -6 volts with respect to ground.
3)	Reset signal:	-8 volts with respect to B+.

3. CIRCUIT DESCRIPTION

3.1 THE BINARIES

The decimal counting unit consists of four binaries, each made up of a pair of p-n-p transistors, connected in a scale-of-ten circuit. The transistor binaries are similar to vacuum tube binaries in that they have two stable states, and are alternately triggered from one state to the other by successive input pulses.

The major difference between the two types of binary is due to the operating characteristics of the transistors. In a transistor, the input impedance is relatively low (in the order of a thousand ohms) when the base potential is negative. This low impedance allows a base current to flow and the transistor is able to conduct. On the other hand, a positive base potential results in a relatively high input impedance (several hundred thousand ohms). Consequently no base current flows and the transistor is, in effect, cut off.

Assume, for example, that the first binary on the schematic diagram is initially in the "zero" state. In this state, Q2 is conduting while Q1 is cut off. A positive input voltage pulse applied through diode CR2 to the base of Q2 drives this transistor to cutoff. As a result, the base current that normally flows is diverted and Q2 therefore stops conducting.

The same input pulse which is applied to CR2 cannot change the state of Q1 since this transistor is already cut off.

As the load current in Q2 decreases, the potential on the collector approaches the level of the B- supply. This change in voltage level is coupled through resistor R3 and capacitor C2 to the base of transistor Q1 and drives Q1 into the active region. As a result, Q1 begins to conduct, and the amplified current flowing through resistor R1 causes the potential on the collector to fall almost to zero. Under these conditions, the divider network consisting of R4 and R7 applies a large enough positive potential to the base of Q2 to keep it cut off.

The binary, now in the "one" state, remains in this stable state until the next positive input pulse arrives. When this happens, Q1 is cut off, Q2 conducts, and the binary thus resumes its original state.

The collector of each transistor in the four binaries is tied to a corresponding terminal of the DCU connector. Thus, the change in voltage level at each collector, as the binary changes state, is available as an output signal. In addition, one output of each binary is also used as the input to the following binary. Consequently, each binary in the DCU reverses state for every two reversals of the preceding binary.

3.2 THE SCALE-OF-TEN CIRCUIT

The scale-of-ten circuit used in the Model 750A DCU is actually a four-place binary counter wired in such a way that it resets to zero on every tenth input pulse. Thus, for the first nine pulses, the binaries operate as in a conventional, 1-2-4-8 counter. At the count of eight, however, the negative potential on the collector of Q8 is fed back through resistor R13 to the second binary. This places a bias on diodes CR8 and CR4 so that the next positive pulse from Q2 will not trigger the second binary.

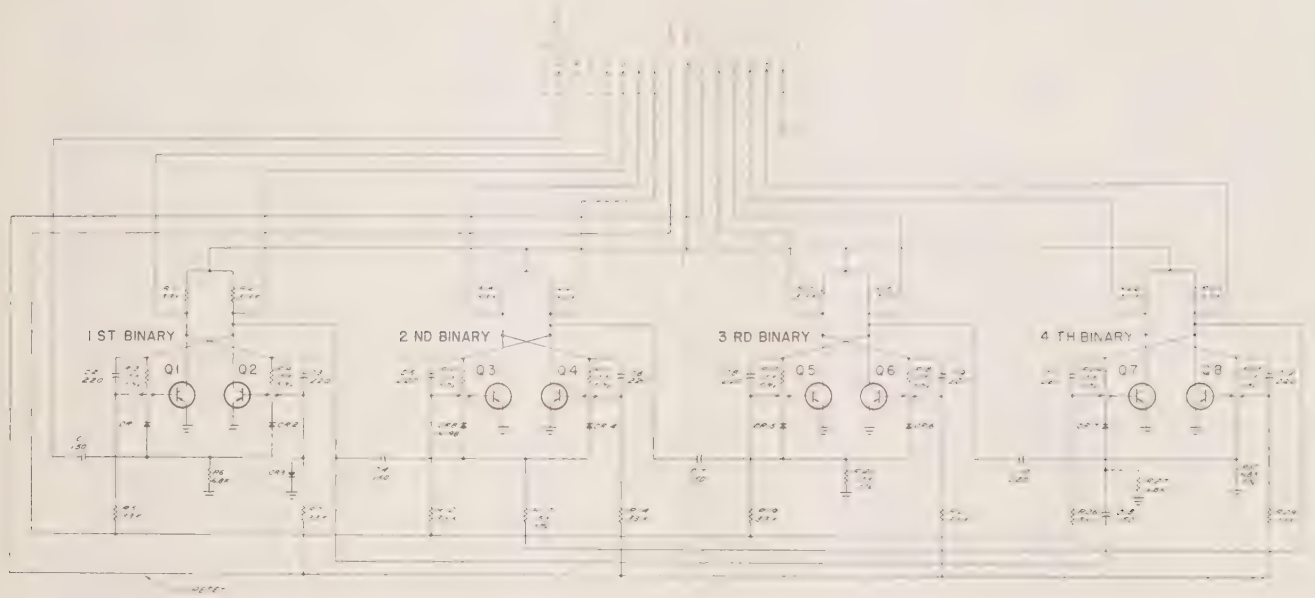
The tenth input pulse, then, flips the first binary to its "zero" state, but the corresponding positive transient at the collector of Q2 cannot trigger the second binary to the "one" state. However, this positive transient, coupled through C13, does trigger the fourth binary to its "zero" state.

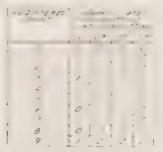
At the tenth input pulse, therefore, all four binaries are in the "zero" state, the bias on diodes CR3 and CR4 has been removed, and the circuit is ready for the next counting cycle.

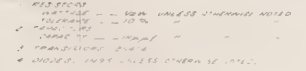
The positive output signal from transistor Q8 produced when the counter goes from nine to zero, can be used to drive another Model 750A DCU. Thus, the counter will supply one input pulse to the next DCU for every ten counts registered.

The number of counts registered by the DCU is represented in binary-coded form by the potentials on the readout lines of the binaries. Since output signals are available from both sides of each binary, either the left-hand or the right-hand set of readout lines can be used for the coded signals. The choice depends only on whether the "one" state of each binary is to be represented by a low or a high potential.

The reset line is connected through a corresponding resistor to the base of the right-hand transistor in each binary. A negative voltage pulse applied to the reset line will therefore cause the right-hand transistors to conduct, and thus trigger all binaries to the zero state.


1 ST BINARY
2 ND BINARY
3 RD BINARY
4 TH BINARY
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8





INSTRUCTION MANUAL

MODEL 751A

DECIMAL COUNT INDICATOR

Beckman/Berkeley Division
Richmond, California

April 1961

WARRANTY

Instruments sold by Berkeley Division, Beckman Instruments, Inc., (hereafter called "the Company") are warranted only as stated below.

Subject to the exceptions and upon the conditions specified below, the Company agrees to correct, either by repair, or, at its election, by replacement, any defect of material or workmanship which develops within one year after delivery of the instrument to the original purchaser by the Company or by an authorized representative, provided that investigation and factory inspection by the Company discloses that such defect developed under normal and proper use.

The exceptions and conditions mentioned above are the following:

(a) Some components and accessories by their nature are not intended to, and will not, function one year. If any such component or accessory manufactured by the Company and part of the item sold fails to give reasonable service for a reasonable period of time, the Company will, at its election, replace or repair such component or accessory. What constitutes reasonable service and what constitutes a reasonable period of time shall be determined solely by the Company after the Company is in posession of all the facts concerning operating conditions and other pertinent factors and after such component or accessory has been returned to the Company, transportation prepaid.

(b) All instruments claimed defective must be returned to the Company, transportation charges prepaid, and will be returned to the customer with the transportation charges collect, unless the item is found to be defective in which case the Company will pay all transportation charges.

(c) The Company makes no warranty concerning components or accessories not manufactured by it, such as tubes, fuses, batteries, etc. However, in the event of the failure of any component or accessory not manufactured by the Company, the Company will give reasonable assistance to the purchaser in obtaining from the respective manufacturer whatever adjustment is reasonable in the light of the manufacturer's own warranty.

(d) Except as stated above, the Company makes no warranty, express or implied (either in fact or by operation of law), statutory or otherwise; and, except to the extent stated above, the Company shall have no liability under any warranty, express or implied (either in fact or by operation of law), statutory or otherwise.

(e) The Company expressly disclaims any liability to its customers, dealers, and to users of its products, and to any other person or persons for consequential damages of any kind and from any cause whatsoever arising out of or in any way connected with the manufacture, sale, repair, replacement of, or arising out of or in any way connected with the use of any of its products.

(f) Representations and warranties made by any person, including representatives of the Company, which are inconsistent or in conflict with the terms of this warranty (including but not limited to the limitation of the liability of the Company as set forth above) shall not be binding upon the Company unless reduced to writing and approved by an officer of the Company.

(g) This warranty shall be governed by the laws of the State of California.

Claims for damage in shipment should be filed promptly with the transportation company.

All correspondence concerning the instrument should specify the model and serial number. This information appears on the company name plate. Any inquiry concerning details of operation, possible modifications, etc., should be addressed to the Sales Department, Berkeley division of Beckman Instruments, Inc., Richmond 4, California.

REPAIR SERVICE

Experienced service personnel and special test equipment are available at the factory to perform any necessary repairs. Every effort will be made to expedite the repair of instruments returned for servicing. Repair work will be performed only upon receipt of a written purchase order or authorization. Instruments to be repaired should be addressed to SERVICE AND REPAIR DEPARTMENT with transportation charges prepaid. Repaired instruments will be returned to the purchaser with transportation charges collect.

Berkeley reserves the right to make changes in design at any time without incurring any obligation to modify equipment previously purchased to conform to subsequent design changes.

BERKELEY DIVISION
BECKMAN INSTRUMENTS, INC.

INSTRUCTION MANUAL REVISION

Model 751A, lots 1 through 5.

Please note that most units in these lots differ slightly from the circuit shown in the schematic diagram. They do not have resistors R24, R25, and R26; in addition, R8, R9 and R10 are 6.8K.

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Model 751A Schematic Diagram

1. INTRODUCTION

1.1 GENERAL DESCRIPTION

The Model 751A Decimal Count Indicator is an electronic plug-in unit which provides a decimal digit display of the counts registered by a Model 750A DCU. By means of a transistor matrix, the indicator unit converts each combination of binary-coded output signals from the DCU into the corresponding decimal digit, displayed as a lighted numeral.

Like the Model 750A DCU, the indicator unit is made up of solid-state components mounted on a printed circuit board.

1.2 TECHNICAL CHARACTERISTICS

Count Display

Illuminated decimal digits

Input

Binary-coded signals from Model 750A DCU

Power Requirements

40 ma at -7.5 v. (±5%)

Construction

Printed card plug-in unit (with 15-pin printed circuit connector).

Dimensions

5/8 inch wide, 4-1/16 inches high, 4-3/8 inches deep

Weight

4-1/2 oz.

2. OPERATION

2.1 MOUNTING THE UNIT

The DCI can be mounted by plugging into a 15-pin printed-card connector. When plugged into a connector having lettered terminals, the unit should be inserted so that the line on the card labelled GND. corresponds to terminal S on the connector.

2.2 MAKING ELECTRICAL CONNECTIONS

To operate the Model 751A DCI, the connector terminals must be hooked up as indicated in Table I.

Table I. DCI Connector Hook-up

MODEL 751A PIN	SOURCE CONNECTION
B	-7.5 volt power supply
D	Pin D of Model 750A DCU connector
F	Pin F of Model 750A DCU connector
M	Pin M of Model 750A DCU connector
P	Pin P of Model 750A DCU connector
S	Ground

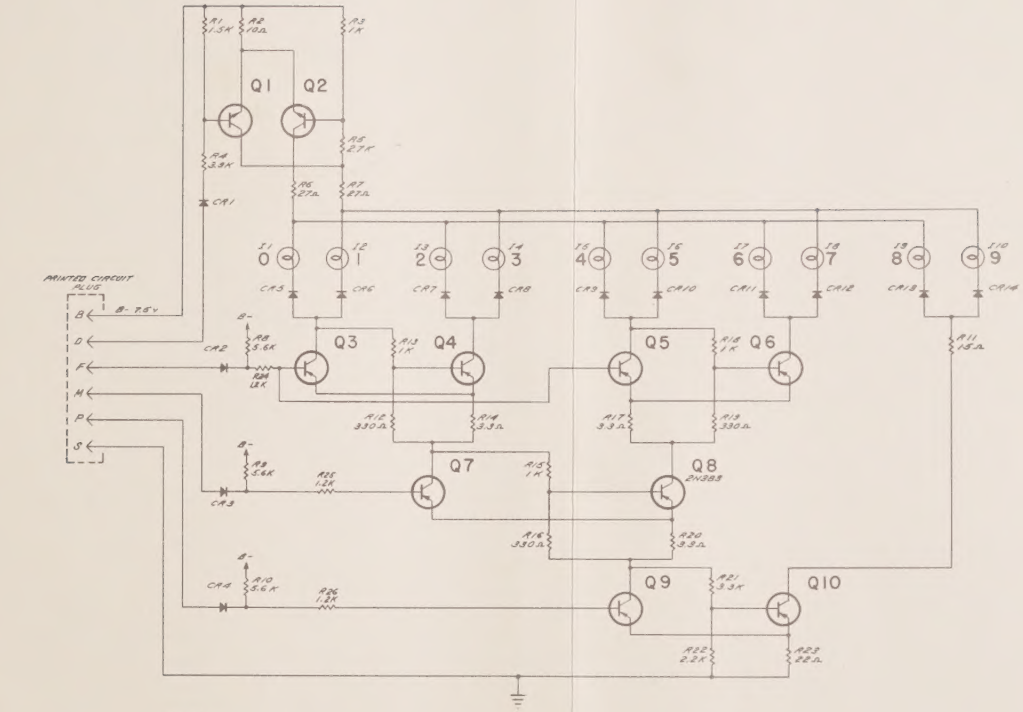
3. CIRCUIT DESCRIPTION

The indicator circuit consists of 10 indicator lamps, numbered from 0 to 9, connected in a transistor matrix. The matrix is made up of five pairs of transistors, each pair acting like a single-pole, double-throw switch. That is, current will flow through the one transistor in each pair which is able to conduct at any given time.

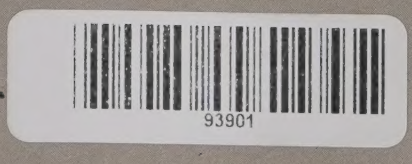
For each combination of potentials at the input terminals (D, F, M and P) there is one combination of conducting transistors. Each such combination provides a closed circuit path to the power source for only one indicator lamp. Furthermore, the indicator lamp thus energized will be the one whose number corresponds to the binary code represented by the input potentials. Thus, each count registered by the associated DCU will be indicated by the correspondingly numbered lamp of the DCI. Table II lists the transistors which should be conducting at each registered count.

Table II. Circuit States

REGISTERED COUNT	TRANSISTORS CONDUCTING
0	Q2, Q3, Q7, Q9
1	Q1, Q3, Q7, Q9
2	Q2, Q4, Q7, Q9
3	Q1, Q4, Q7, Q9
4	Q2, Q5, Q8, Q9
5	Q1, Q5, Q8, Q9
6	Q2, Q6, Q8, Q9
7	Q1, Q6, Q8, Q9
8	Q2, Q10
9	Q1, Q10



NOTE:
1. RESISTORS:
   WATTAGE ——— ½ W EXCEPT AS NOTED.
   TOLERANCE ——— 10% " " "
2. INDICATING LAMPS: I1 TO I10 ARE GE-1779
3. TRANSISTORS: Q1 & Q2 — TYPE 2N1274
   Q3 THRU Q10 - BERKELEY PART NO. B-8244 (2N1190 OR EQUIV.)
4. DIODES ARE BERKELEY PART NO. B-8300 (1N35 SELECTED FOR 75 MA. FORWARD CURRENT AT 1 VOLT).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